Military Spending and Growth: An Empirical Exploration of Contingent Relationships

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April 2013

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Abstract

This analysis clarifies the ambiguous results from military spending and economic growth literature where the impact of military expenditure is frequently found to be non-significant or negative. Investigation re-examines effects of military spending on growth by analysing this relationship contingent on initial income per capita using recent advances in panel estimation methods and unique dataset on military expenditure. The findings reveal that while growth falls with higher levels of military spending, the marginal impact of military spending is increasing in initial income levels. In contrast to previous findings from the literature, this increase is consistent across different income groups and type of economies, and monotonic in direction going towards zero for sufficiently higher income level countries.

Keywords: Military expenditure; Economic Growth; Contingency

JEL classification: H56; O11

I would like to express my sincere gratitude to Andrew Mountford and Jonathan Temple for helpful comments and suggestions.

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1. Introduction

The economic effects of military spending continue to be the subject of considerable debate, with a lack of consensus in the literature. How does military expenditure affect a country's economic growth? And how do these effects vary across economies? These are important questions, as the effects of military spending, on one hand, may just represent a budgetary burden which is necessitated by a country's need for some level of security; on the other hand, it may also serve for growth by delivering significant "peace dividends" and attract additional revenues into a country's budget through defence industry (e.g., arm trading, technology transfers).

This investigation makes a contribution to the debate on the economic effects of military spending, in light of the ambiguous outcomes found in the military spending and economic growth literature, by reassessing the relationship contingent on the level of initial income per capita. Although growth falls with higher levels of military spending, the results reveal that conditional on the values of other independent variables, the marginal impact of military spending is increasing in initial income levels. In particular, this relationship is negative and significant amongst poor countries, while typically not significantly different from zero amongst richer countries. In contrast to previous research, this contingency pattern continues to hold under an alternative modelling strategy in which the data set is stratified into different income categories and types of economies, as well as its robustness along several dimensions; and is monotonic in direction, converging towards zero for sufficiently high income level countries, which explains the ambiguity in previous findings.

The debate regarding the economic effects of military spending is founded in the contribution of Benoit (1973, 1978) which ignited a subsequent tranche of research employing a variety of econometric models, reflecting different theoretical perspectives. Keynesian, neoclassical and structuralist models were applied using a variety of specifications, econometric estimators and types of sample in cross-sectional, time-series or panel datasets. The diversity of results led to arguments for case studies of individual countries and relatively homogeneous groups of countries. However, the literature has not reached a consensus. For instance, Dunne and Uye (2009) in a survey of 102 studies on the economic effects of military spending, report that almost 39% of the cross-country studies and 35% of the case studies find a negative effect of military spending on growth, with around 20% finding positive impacts for both types of studies.[1]

Clearly military spending, conflict and economic capacity (education, governance, institutions and resource endowments), all interact to influence growth. However all the interactions of these channels and their influence on economic growth will vary on the countries under examination and depend on their economic/budgetary constraints. For example, a relatively advanced developing country, such as one of the “Asian Tigers” by investing into military sector will have interests over the industrial impact of its involvement in arms production, the technology and the foreign direct investment benefits vs. the opportunity costs, while a poorer African economy may be more concerned with the conflict trap it finds itself in, i.e. investing into military sector instead of directing budgetary sources into welfare-improving purposes is likely to be more detrimental in poorer countries.

A simple illustration of how the impact of military spending on economic growth can vary conditional on countries’ income level, presented in Figure 1, indeed provides support for this view also casting some doubt on the desirability of pooling all the nations together in the econometric analysis without taking into account the military spending contingency through income.[2] The plots illustrate significant negative impact of military expenditure on growth for

[1] Previous surveys of the military spending and growth literature also include Chan (1987), who found a lack of consistency in the results; Ram (2003) who reviewed 29 studies, concluding that there is little evidence of a positive effect of defence outlays on growth, but that it was also difficult to say that the evidence supported a negative effect. Dunne (1996, chap. 23) covering 54 studies concluded that military spending had at best no effect on growth and was likely to have a negative effect; and Smith (2000) concluded that the large literature did not indicate any robust empirical regularity, positive or negative, though he suggested there is a small negative effect in the long run. Smaldone (2006) in his review of Africa, considers military spending relationship to be heterogeneous, but feels that variations can be explained by intervening variables. The effect can be both positive and negative but are usually not pronounced, although the negative effects tend to be wider and deeper in Africa and most severe in countries experiencing legitimacy/security crisis and economic/budgetary constraints.

[2] Scatter plots and fitted relationships between the variables of interest for four income groups are achieved using partial regressions which are obtained in two stages. First, both the dependent variable and the isolated independent variable are projected onto the additional set of regressors under consideration. Next, the fitted dependent variable is regressed against the fitted independent variable. In each case, the residuals of a growth regression on a set of variables are compared with the residuals of military expenditure regression on the same variables. The figures are produced using OLS panel regressions where growth and military expenditure is related linearly.

the low income subsample, while this effect becomes less and less negative going towards zero for relatively richer countries, perhaps reflecting a contradictory effect induced by positive income effects gained as peace dividends which cancel the detrimental effects out.[3]

The remainder of the paper is organized as follows. The methodology and data employed are described in Section 2. Section 3 presents the estimation results using more formal analysis which confirm the presence of the contingency that plots above illustrate, as well as its robustness along several dimensions; and Section 4 concludes.

2.1. Empirical Methodology

Many different estimators have been used to examine the relationship between growth and military spending, with associated advantages and disadvantages to each method. This section begins with a brief discussion of these estimators in order to motivate the approach to estimation analysis. Then the discussion turns to the method used to explore the potential contingencies in the relationship between military expenditure and growth.

Letting the subscripts *i* and *t* represent country and time period respectively, the estimated growth model with introduction of military expenditure can be written as

$$y_{it} - y_{i(t-1)} = \alpha\, y_{i(t-1)} + \theta_1 mil_{it} + \beta' Z_{it} + \mu_t + \xi_i + \varepsilon_{it} \qquad (1)$$

where y is log of real per capita income, mil_{it} is military spending, Z_{it} is a vector of additional control variables, μ_t is a period-specific constant, ξ_i is an unobserved country-specific effect, and ε_{it} is an error term.[4]

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[3] Dunne and Tian (2013) also demonstrates that the impact of military expenditure on growth is heterogeneous when countries are stratified into different income groups. Military spending appears to have been more damaging for poorer countries, however showing non-monotonic change in the behaviour when moving to higher income distribution (see also Dunne, 2012).

[4] The analysis employs standard growth model with introduction of military expenditure which is similar to the benchmark specification used by Aizenman and Glick (2006). As discussed in Dunne *et al.* (2005), taking into account the theoretical weaknesses generated by the Feder-Ram or Solow model, the extended Barro model used by Aizenman and Glick (2006) has comparative advantage to explain both military expenditure and growth. Here, the analysis does not purport to test these theoretical models; rather working in the tradition of cross-country growth literature, the investigation presents empirical evidence of the existence of a contingent relationship between military expenditure and growth.

As discussed in Caselli *et al.* (1996), the consistency of OLS estimators depends on the assumption that the country-specific effect ξ_i is orthogonal to other right-hand side variables. This assumption in growth regressions is clearly violated due to the presence of lagged income as an explanatory variable: i.e. $E[y_{i(t-1)}\xi_i] \neq 0$. Thus, a first step to achieve consistent estimates starts by eliminating the country-specific term.

One approach to eliminate ξ_i is using a fixed effects estimator or the closely-related between-effect estimator that involves the implementation of a country-specific constant term. Another approach instead introduces the implementation of a country-specific random variable that is uncorrelated with the included regressors and may be realized using random-effects estimation or seemingly unrelated regression (SUR) (see Greene, 2003, for details regarding these estimators). These strategies deal successfully with estimation inconsistencies generated by non-orthogonality between explanatory variables and country-specific effects but, as Caselli *et al.* (1996) note, inconsistencies will continue to be problematic if the explanatory variables are not strictly exogenous.

To deal with inconsistency and likely endogeneity issues, Arellano and Bond (1991) proposed a GMM difference estimator that is derived by taking first differences of all variables, and uses lagged levels of the explanatory variables as instruments. However, as discussed in Easterly and Levine (2001), the difference estimator has the statistical shortcoming that if regressors are persistent, then lagged levels of explanatory variables are weak instruments. Further, taking differences of the original level equation reduces the time dimension of the sample and leaves information about the level relationship between explanatory variables and growth unused. An additional complication associated with the estimation in differences involves potential measurement errors associated with the explanatory variables.[5]

To overcome these issues, Arellano and Bover (1995) and Blundell and Bond (1998) developed a system GMM estimator that combines the differenced model with the levels

[5] Hauk and Wacziarg (2004) have studied the impact of measurement error on the performance of the estimators discussed, explicitly in the context of the growth regressions. They conclude the following: In the presence of measurement error, fixed-effects and difference estimators tend to underestimate the coefficient of lagged income and parameter values associated with the additional explanatory variables. In contrast, the cross-sectional OLS estimator and the panel SUR estimator both tend to provide relatively accurate estimates of lagged income, while overestimating the magnitude of parameters associated with the additional explanatory variables.

model. However, it should be noted that the move from the difference to the systems estimator also involves a cost: the adoption of additional assumptions regarding orthogonality between the country-specific effect and the regressors, which are difficult to justify *a priori*.

Lacking clear guidance regarding the choice of estimators, the analysis follows Easterly and Levine (2001) (see also DeJong and Ripoll, 2006) and report results obtained from several alternative estimators: cross-section OLS, SUR, Fixed effects, Difference and Systems GMM.[6] For the additional sensitivity analysis Systems GMM is the preferred estimator.

The treatment of each regressor according to their exogeneity levels under the GMM estimators is based on upper and lower bound conditions (Roodman, 2006). To ensure that the estimated effect is not driven by the number of instruments, the analysis also employs the "1 lag restriction" technique followed by Roodman (2009) that uses only certain lags instead of all available lags as instruments.[7]

As an additional robustness check, to identify potential outlier countries that might affect the estimation results, the analysis employs a strategy advocated by Belsley *et al.* (1980). It involves the application of the DFITS statistic to flag the countries associated with high combinations of residual and leverage statistics.

Turning to the method used to capture potential contingencies in the relationship between military expenditure and growth, two approaches are employed. Under the first, the baseline approach involves including in (1) additional explanatory variable constructed as the product of military expenditure and log of initial income. The hypothesis is that the direct impact of

[6] In addition to these estimates, between-effects and random effects estimates were calculated but are not reported, because, as characterized above, the between-effects estimator is closely related to the OLS estimator and the random-effects estimator is closely related to the SUR estimator, and therefore the results obtained using these additional estimators are quantitatively similar to those reported here. Moreover, the fixed-effects estimator and the difference GMM estimator leads to quantitatively similar results as well, however both estimators are reported since a large body of research analyses in the defence literature is based on these estimators.

[7] Along with coefficient estimates obtained using GMM estimators, tables also report three tests of the validity of identifying assumptions they entail: Hansen's (1982) J test of over-identification; and Arellano and Bond's (1991) AR(1) and AR(2) tests in first differences. AR (1) test is of the null hypothesis of no first-order serial correlation, which can be rejected under the identifying assumption that ε_{it} is not serially correlated; and AR (2) test is of the null hypothesis of no second-order serial correlation, which should not be rejected. In addition, to deal with heteroskedasticity, the Windmeijer (2005) small-sample correction is applied.

military spending is negative, while marginal impact is increasing in income levels implying that the effect of military expenditure becomes less negative at higher levels of income. The second approach involves stratifying the data set into different subsamples; and separate specifications of (1) are estimated, where growth linearly responds to the changes in military expenditure. Therefore four income groups are defined: high income (rank 4) countries; upper-middle income (rank 3) countries; lower-middle income (rank 2) countries; and low-income (rank 1) countries.[8] Analysis of these relationships demonstrates that evidence of a significant interaction term effect arises by monotonic changes in the impact of military expenditure on growth across different subsamples.

2.2. Data and Descriptive Statistics

The analysis is based on a balanced dynamic panel dataset that consists of 89 countries over the 1970-2010 period.[9] The panel dataset is constructed by transforming time series data into non-overlapping five year averages. This procedure smoothes out short-run cyclical fluctuations thereby helping the analysis to concentrate on long-run growth effects (Knight *et al.*, 1996). The dependent variable is logged per capita real (Laspeyres) GDP growth constructed using data from the Penn World Tables (PWT 7.1). Log of initial income per capita is used as regressor.

Military spending is measured as the average ratio of military expenditures to GDP, using data collected from the SIPRI (Stockholm International Peace Research Institute) Yearbooks. As online data tables relate only to the period from 1988 onwards, military expenditure shares for the previous periods are collected and inputted directly from the SIPRI Yearbooks in order to extend the time horizon.[10]

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[8] The cut-off levels of income rankings are taken as in DeJong and Ripoll (2006), where country classifications are obtained by mapping classification thresholds as defined by the World Bank's income measures into the corresponding Penn World income measures. The resulting definitions are as follows: high-income level countries are those with real per capita GDP above \$11,500; upper-middle income level countries those between \$5,500 and \$11,499; lower-middle income level countries are between \$2,650 and \$5,499; and low-income level countries those with less than \$2,650. Note that the classifications during the analysis are based on 1970 income rankings.

[9] See Appendix Tables A and B for the list of countries and descriptive statistics.

[10] Data on military spending was initially collected starting from the period of 1959 as the PWT data on real GDP per capita is not available for most countries before this date. However, given the trade off between having longer time series dimension and losing cross-country sample observations for which data on all variables is

Along with numerous advantages of having longer time horizon, the access to military data before 1990 period facilitates to investigate whether the ambiguous findings in the literature are driven by the changes in the nature of conflicts after the post-Cold War era. As discussed in Kaldor (1999), the end of proxy-wars and superpower involvement in local wars did not reduce the number of conflicts, but did reduce the intensity of military battles. There are fewer real military battles than in the past, but attacks on civilians increased showing a dominance of civil or intra-state conflict.

The investigation also uses a standard set of control variables typically employed in the empirical growth literature (e.g., Barro and Lee, 1994; Barro and Sala-i-Martin, 1995, Ch. 12). It includes two proxies for human capital: the log of average years of schooling attained by males aged 15 and over, obtained from Barro and Lee data set, and the log of life expectancy, as reported by the United Nations; and also population growth rate,[11] real private investment as a percentage of real GDP and degree of economic openness, all as reported in the Penn World Tables (PWT 7.1).

Table 1 provides summary statistics for military expenditure share and growth over different income groups. Two aspects of these statistics are of particular interest in the analysis. The first is the tendency that relatively richer countries tend to enjoy relatively rapid growth. Average growth rates increase monotonically when moving from the lower to higher income classifications: from 1.473% (s.d. 2.136) for low-income countries to 2.095% (s.d. 0.442) for high-income countries. The second aspect of these statistics is that relatively rich countries tend to spend relatively more on the military sector. The average military expenditure share tends to increase when moving from the low to high income classifications (with the exception of the upper-middle income group): from 2.637% (s.d. 1.782) to 3.297% (s.d. 3.128).

3. Empirical Results

Figure 2 illustrates how the relationship between military spending and economic growth is contingent on the level of income. A positive relationship between growth and the interaction

available, the analysis was constrained to the period of 1970 and onwards, yielding the balanced sample of 89 countries.

[11] Growth rate of population employed in the analysis is computed as log of $n + g + \delta$, where n is average population growth rate; g is the rate of technical progress and δ is the rate of depreciation of the stock of physical capital investment and $g + \delta$ is assumed to be equal to 0.05, following Mankiw *et al.* (1992).

term indicates that the marginal impact of military expenditure on growth is increasing in initial income. In turn, military expenditure significantly decreases growth in the low- and lower-middle income subsample, while this effect is positive, albeit insignificant, in the upper-middle and high-income subsample. Taking the evidence from Figure 2 (see also Figure 1) as preliminary, it is of interest to confirm the presence of the contingency that these figures illustrate using more formal analysis.

Estimation results for the impact of military expenditure contingent on initial per capita income are presented in Tables 2-9. Table 2 reports the coefficient estimates from a non-linear estimation. Table 3 displays the estimation results using the alternative specification, where the relationship is estimated linearly using low-half and high-half income subsamples of the data. Table 4 runs the same exercise using the four income rankings, while Table 5 examines the linear relationship between military spending and growth for a relatively homogenous group of countries. Table 6 and 7 examine the sensitivity of the estimates of the variables of interest to the presence in the data of several alternative subsets of countries, singled out for certain unusual aspects of their growth rate experiences and military expenditure shares. Table 8 exercises the contingency relationship for different time windows. Finally, Table 9 uses alternative measures for income and military spending as additional robustness check.

3.1. Military Spending and Growth Contingencies

While not reported in the tables, a discussion of the global relationship observed between military spending and growth excluding the military expenditure and initial income interaction term from the baseline specification is pertinent. Using the full sample, a moderate negative relationship is estimated, and the estimated impact on growth of one percentage point increase in military expenditure is approximately -0.04 percentage points (the significance of the coefficient estimates exhibits sensitivity to the particular estimator being employed).

Inclusion of contingencies into the model, as reported in Table 2, demonstrates that the negative relationship is evident only among relatively poor countries, and a positive sign for the interaction term is obtained in all cases. In contrast to the cross-sectional OLS, panel estimators demonstrate significant impact of both linear and non-linear terms in all cases when the outliers are removed.[12]

Splitting the data set into subsamples as reported in Table 3, one including low- and lower-middle income countries, the other including upper-middle and high-income countries, and estimating separate linear specifications for each yields results which are, in general, consistent with the findings from Table 2. For the low and lower-middle subsample, the military expenditure coefficients are all estimated as negative and in most cases significant. For the upper-middle and high-income subsample, a mixed picture emerges: the estimates oscillate between positive and negative values and rarely differ significantly from zero (in 8 cases out of 10).[13] Regarding quantitative significance, using the estimates produced by the systems estimator, the impact on growth of one percentage point increase in military expenditure is estimated as -0.133 percentage points among low- and lower-middle income countries, and -0.002 percentage points among upper-middle and high-income countries.[14]

A similar picture emerges when the four income rankings are considered. There is a notable difference across the estimates when investigation moves from the poorest countries to the richest.[15] For the poorest countries, those with index values of 1, all fourteen sets of quantitative-significance estimates are negative, showing high significance in most cases. Regarding quantitative significance, using the estimates produced by the systems estimator (Panel B, column b in Table 4), the impact on growth of one percentage point increase in military expenditure is estimated as -0.130 percentage points among the income rank 1 countries. This finding reveals that the significant impact from military spending for the low-half income distribution is mainly driven by the poorest economies. For the relatively richer

[12] Note that over-identification test condition is not satisfied for GMM difference (column b).

[13] Note that the condition of second-order serial correlation for GMM difference (column b) is violated for upper-middle and high-income countries. Therefore, the only estimator that demonstrates a significant impact of military expenditure for the high-half subsample is the fixed effects model.

[14] These measures are obtained by dividing the coefficient estimates by the time span between income observations (5 years).

[15] The test of the equality of the military expenditure estimates for the poorest and the richest countries produced by the systems estimator (Panel B, column b in Table 4) rejects the null that the impact is the same.

countries, the impact of military expenditure becomes less and less negative, converging towards zero.[16]

In a further effort to investigate whether this heterogeneity for military spending effects is somehow different across marginal changes throughout subsamples, Figure 3 plots the estimated coefficients of military expenditure along with their relative confidence bands (at 95% level) for infra-marginal changes in income levels where each interval are selected so to maintain the same distance between the lower and upper bounds for each interval. The results are supportive with the evidence above confirming monotonic increase in military spending effects when moving from lower to higher income level economies.

The results from splitting the countries into more homogenous groups according to their economic and geographical characteristics, and estimating separate linear specifications for each group reveal essentially the same story. The negative effect of military spending is estimated to be wider, deeper and robustly significant for Sub-Saharan Africa (SSA) and Middle East and North Africa (MENA) countries (see also e.g., Smaldone, 2006; Hamid, 2012). Interestingly, it turns out that the elimination of Iran, Israel and Jordan from the MENA subsample alters the significance of the military expenditure estimates. This result can be explained by the high demand for security in these countries, and the non-linear impact of military spending when a country is faced with high threat (see Aizenman and Glick, 2006). Another interesting feature worth to mention here is that significant positive effect from military spending for East Asia and the Pacific region countries is driven by big arm producers like China and "Asian Tigers" countries, and becomes insignificant when these countries are removed from the subsample. Overall, these results demonstrate that the negative and significant impact from military expenditure across countries is mainly the case for SSA and MENA region where for the rest of the subgroups the results are mixed, with the estimates varying in sign and rarely demonstrating a robust significant impact.[17]

[16] For the richest countries in the world, the significance of military expenditure under GMM difference is not robust when using the "1 lag restriction" technique. Therefore, the only estimator that demonstrates a significant impact of military expenditure is the fixed effects model out of the five estimators (see Panel B in Table 4). Note that this was also the case for high-half subsample in Table 3. This might suggest that some caution should be taken when employing the fixed effects or GMM difference estimators in the military spending and growth analysis.

[17] The estimated impact of military expenditure does not differ significantly from zero in 11 cases out of 14 for Advanced Economies and East Asia and Pacific; and in 12 cases for Latin America and Caribbean subsample.

Thus, the results from Tables 3-5 imply that the contingency pattern from modelling military spending and growth as shown in Table 2 is robust and continues to hold under alternative sample splitting methodologies. All in all, these findings suggest that a negative and significant relationship is only apparent among poor economies, and illustrates a typically insignificant impact among relatively richer economies. Moreover, the behaviour of this pattern is monotonic in direction, converging towards zero for sufficiently high income level countries, which therefore explains the ambiguity in findings from previous research.

Coefficient estimates of additional explanatory variables enter mostly with the expected signs. Estimated coefficients on lagged income and the investment ratio are, respectively, negative and positive, statistically significant, and typically indicate strong quantitative effects. Life expectancy also exhibits a strong relationship with growth. The negative impact of trade openness is mainly driven by low-half income distribution countries, where a positive sign is apparent only among upper-middle and high-income countries (see also DeJong and Ripoll, 2006). Surprisingly, schooling exhibits a negative relationship with growth when interaction term is employed; but this effect disappears when alternative sample splitting strategies are considered. Finally, the estimated effect of population growth is mostly negative and typically insignificant.

3.2. Robustness Checks

Beyond the robustness checks as described above, special attention is paid to the potential influence on the results of several subsets of countries. The first collection of subsets features countries singled out on the basis of certain unusual aspects of their growth rate experiences during the time period spanned by the sample. Results of this exercise are reported in Table 6 for three subsets of countries. For each subset, Table 6 reports the list of countries, their 1970 and 2005 income rankings, their average military expenditure shares and growth rates measured over the entire sample period, and the coefficient estimates obtained for the military spending and its interaction with initial income given their removal from the sample in addition to outlier countries. Only estimates obtained using systems estimator are reported, but the general flavour of the exercise is consistent across estimators. For ease of comparison, the estimates obtained given the exclusion of the four outlier countries, as in Table 2 (column b), are also reported. The additional subsets of countries singled out on the basis of unusual aspects of their growth rate experiences include the twelve escapees from the low-income group, the sixteen escapees from the low and lower-middle income group, and the Asian Tigers.

Strikingly, the coefficient estimates change very little given the removal of any one of the subsets under consideration; and in all cases, enter significantly at conventional levels. For both the linear and non-linear terms of military expenditure, the estimates obtained given the removal of each subsample lie within one standard deviation of the full-sample estimate.

The second collection of subsets includes countries singled out due to the maintenance of high shares of military expenditure in addition to outlier countries. Three subsets are considered: the two low-income and the two high-income countries with the highest military expenditure shares specified as those with military spending levels above the top decile; and the union of these two subsets. The impact of removing these subsets of countries is reported in Table 7. Once again, point estimates change very little. What does change somewhat is statistical significance in the case when the exclusion of the second and the third subsets are employed. However, the general pattern of results reported in Table 2 remains apparent given the exclusion of these countries from the sample.

Collectively, the results from Tables 6 and 7 suggest that the contingency relationship between military expenditure and growth does not seem attributable to the influence of a small number of exceptional countries.

Using time effects in all regressions controls for any common factor that could affect all countries in any five-year interval. However, it is of interest to check if the results hold when different time windows are used for the estimation. A sensitive issue is that the post-Cold War era led to important changes in the nature of conflicts by reducing the intensity of real military battles than in the past, and whether these changes from the period after the end of Cold-War alter the results (Kaldor, 1999). The baseline time span in the analysis is 1970-2010. Table 8 considers more restrictive information available for three successive periods of minimum 20 years: 1970-1995; 1980-2010; 1990-2010. The result holds significantly in the first and third periods but not in the second (significant only at 18% level), suggesting that the findings from contingency relationship between military expenditure and growth are also robust when the analysis is restricted to the post-Cold War era. Overall, the general pattern of results reported in Table 2 remains apparent under alternative restrictions of the dataset to different time windows.

Table 9 presents the robustness test using alternative income and military expenditure measures. As discussed in Johnson *et al.* (2013), using PWT income data can be problematic and affect cross-country growth estimates because of variability across different versions of the PWT. Although using low-frequency data is robust to these inconsistencies in data revisions, as a check on results, column 1 employs GDP per capita from World Development Indicators (WDI) as an alternative income measure. Column 2 instead uses an alternative approach to capture potential contingencies in the relationship between military spending and growth by replacing the product of lagged income and military expenditure with an alternative one: the product of military expenditure and 1970 income rankings which takes values 1 (for the poorest income countries) to 4 (for the richest countries). Column 3 employs the World Bank data as an alternative source for military expenditure share instead of SIPRI.[18] In all three cases, the main results hold.[19]

Overall, the sensitivity results provide supportive evidence of a contingent relationship between military expenditure and growth conditional on initial income levels.

4. Conclusion

The empirical analysis shed light on the rationale behind ambiguous outcomes from previous research by reassessing the relationship between military spending and growth contingent on a country's economic and budgetary constraints. The findings have revealed the presence of a significant interaction effect under which the marginal impact of military expenditure on growth is increasing in initial income. In particular, investigation finds that while growth falls with higher levels of military spending among the world's poor countries, the impact of military expenditure on growth becomes less and less negative as a country becomes richer, and this contingency pattern is monotonic in direction, going towards zero for less budgetary constrained countries.

The analysis suggests a number of paths for future research concerning the effect of military activity on economic growth through income. A particularly promising avenue of future research would be to analyze the role of the existence of a defence industry in a country.

[18] Note that employing the World Bank measure of military expenditure share restricts the data set to 1990-2010 period.

[19] Separate linear relationship of military expenditure and growth is also estimated using WDI income data for low-half and high-half income subsamples and four income rankings. The results are qualitatively similar to that presented here.

Specifically, it is of interest to see whether the difference in the impact of military expenditure across income groups is driven by arm trading, i.e. export of military production which might offset the detrimental impact of military expenditure by attracting more income revenues.

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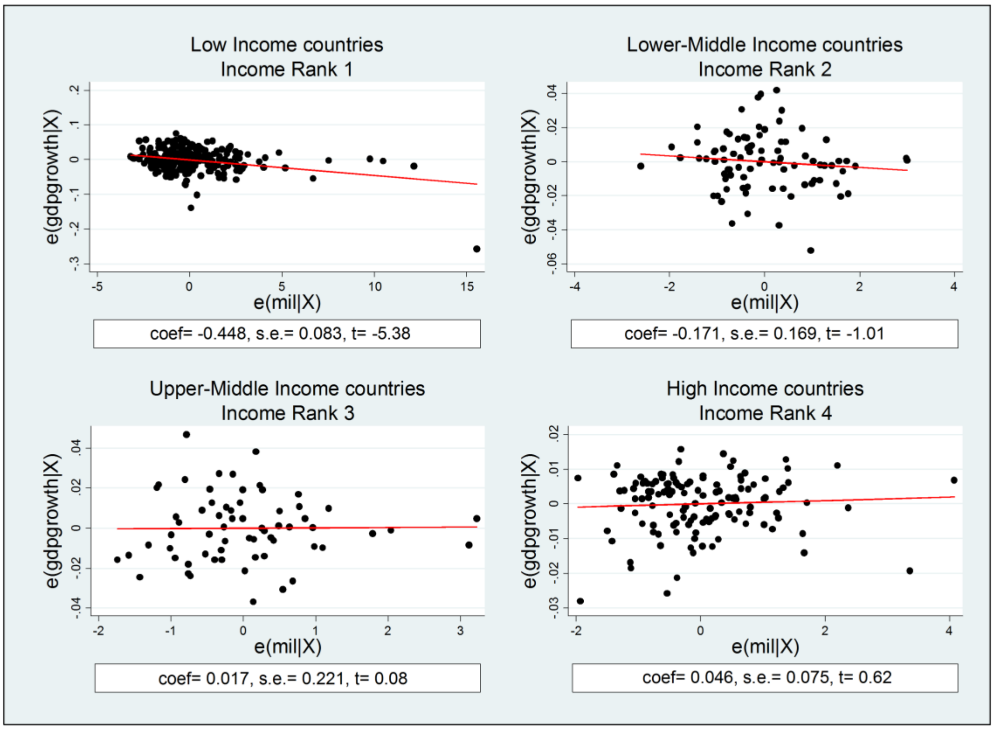
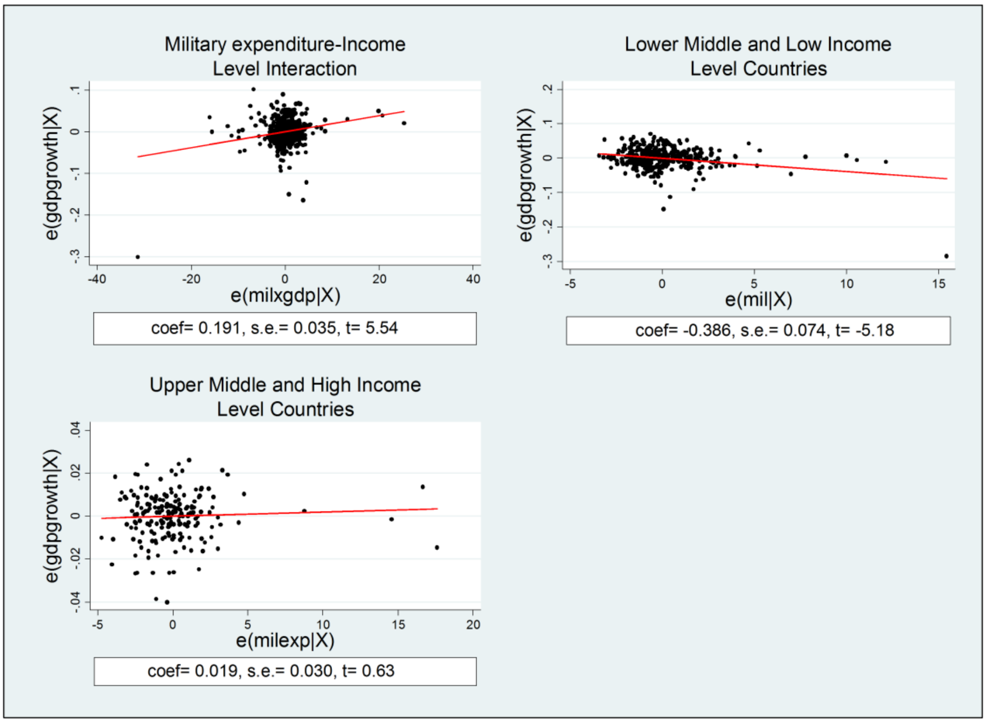
Figure 1: Partial Regression Plots for Military Expenditure and Growth



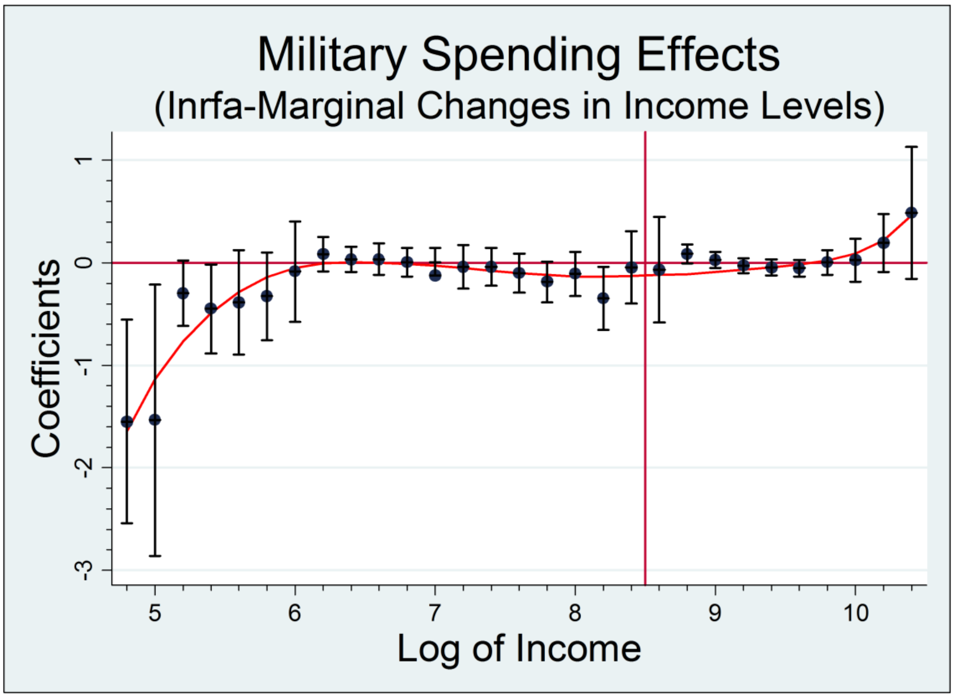
Note: The set of regressors includes log of initial income, log of population growth, log of life expectancy, investment ratio, log of openness and schooling, and time fixed effects. The figures are produced using OLS panel regressions, excluding outliers as defined in Table 4.

Figure 2: Partial Regression Plots for Military Expenditure and Growth



Note: The set of regressors includes log of initial income, growth rate of population, log of life expectancy, investment ratio, log of openness and schooling, and time fixed effects. Partial regression plot for interaction term also includes military expenditure into specification. The figures are produced using OLS panel regressions, excluding outliers as defined in Tables 2 and 3.

Figure 3: Military Expenditure Effects by Infra-Marginal Changes in Income Levels



Note: The graph plots the estimated impact of military spending on growth conditional on infra-marginal changes in income levels. The infra-marginal intervals are selected so to maintain the same distance between the lower and upper bounds for each interval. The set of regressors also includes log of initial income, growth rate of population, log of life expectancy, investment ratio, log of openness and schooling, and time fixed effects. Black spikes represent 95% confidence bands; the vertical line corresponds to the threshold line between low and high-half income level countries. Red line represents local polynomial smoothed trend for the impact of military spending on growth when moving from lower to higher income categories. The method of estimation is the panel least squares with robust standard errors.

Table 1: Descriptive Statistics for Growth and Military Expenditure

Summary Statistics						
Sample split	Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
Full sample	Mil. exp.	89	2.789	2.189	0.281	14.964
	Growth	89	1.730	1.709	-5.338	6.900
Low income	Mil. exp.	44	2.637	1.782	0.281	9.049
	Growth	44	1.473	2.136	-5.338	6.900
Lower-middle	Mil. exp.	16	3.026	2.385	0.933	11.247
	Growth	16	1.787	1.427	-0.678	5.467
Upper-middle	Mil. exp.	11	2.219	1.526	0.364	4.693
	Growth	11	2.078	1.425	0.502	5.272
High income	Mil. exp.	18	3.297	3.128	1.067	14.964
	Growth	18	2.095	0.442	1.086	2.798
Lower Mid./Low	Mil. exp.	60	2.740	1.947	0.281	11.247
	Growth	60	1.557	1.965	-5.338	6.900
High/Upper-Mid.	Mil. exp.	29	2.888	2.656	0.364	14.964
	Growth	29	2.089	0.918	0.502	5.272

Note: All descriptive statistics are based on cross country averages for the 1970-2010 period.

Table 2

Non-linear Specifications of Military Expenditure

Dependent Variable: Logged per capita real (Laspeyres) GDP growth

	OLS		**SUR**		**Fixed effects**		**Difference GMM**		**System GMM**	
	a	b	a	b	a	b	a	b	a	b
Initial GDP p.c. (log)	-0.003	-0.004	-0.010***	-0.011***	-0.029***	-0.029***	-0.044**	-0.051	-0.016***	-0.021***
	(0.004)	(0.003)	(0.002)	(0.002)	(0.004)	(0.005)	(0.018)	(0.037)	(0.005)	(0.006)
Mil. exp/GDP	**-0.354**	**-0.505**	**-1.396*** **	**-1.816*** **	**-2.199*** **	**-2.649*** **	**-1.282**	**-1.782***	**-2.094**	**-3.021** **
	(0.572)	**(0.430)**	**(0.269)**	**(0.294)**	**(0.376)**	**(0.398)**	**(0.788)**	**(0.895)**	**(1.446)**	**(1.444)**
							[0.107]		**[0.151]**	
Mil*GDP	**0.038**	**0.053**	**0.149*** **	**0.191*** **	**0.243*** **	**0.286*** **	**0.135**	**0.177***	**0.225**	**0.322** **
	(0.060)	**(0.045)**	**(0.032)**	**(0.034)**	**(0.049)**	**(0.050)**	**(0.090)**	**(0.099)**	**(0.161)**	**(0.157)**
							[0.138]		**[0.164]**	
Pop. growth (log)	-0.016	-0.021*	-0.003	-0.005	0.013	0.012	-0.003	0.008	-0.019	-0.032***
	(0.015)	(0.011)	(0.007)	(0.007)	(0.008)	(0.008)	(0.017)	(0.022)	(0.012)	(0.012)
Life expectancy (log)	0.069**	0.073***	0.093***	0.093***	0.055***	0.052**	0.090	0.042	0.130***	0.166***
	(0.027)	(0.019)	(0.012)	(0.013)	(0.019)	(0.021)	(0.072)	(0.106)	(0.040)	(0.058)
Investment/GDP	0.082***	0.052***	0.106***	0.094***	0.161***	0.162***	0.152***	0.132**	0.248***	0.251***
	(0.029)	(0.019)	(0.013)	(0.013)	(0.019)	(0.019)	(0.039)	(0.051)	(0.047)	(0.056)
Openness (log)	-0.002	-0.003	-0.007***	-0.008***	-0.011**	-0.015***	-0.008	-0.007	-0.014*	-0.023**
	(0.003)	(0.003)	(0.002)	(0.002)	(0.004)	(0.004)	(0.014)	(0.015)	(0.007)	(0.009)
Schooling (log)	-0.009*	-0.010**	-0.008**	-0.007**	-0.020**	-0.017*	-0.039*	-0.036	-0.006	-0.020*
	(0.005)	(0.004)	(0.003)	(0.003)	(0.009)	(0.009)	(0.021)	(0.025)	(0.007)	(0.011)
Observations	89	85	695	665	695	665	601	575	695	665
SPECIFICATION TESTS (*p* -values)										
(a) Hansen Test:							0.772	0.025	0.897	0.986
(b) Serial Corr. Test:										
First-order							0.008	0.075	0.000	0.001
Second-order							0.247	0.191	0.492	0.387

Note: Columns "a" estimate military expenditure and economic growth relationship for the full sample, while columns "b" estimate the same specification removing outliers. All estimated results for GMM estimators are achieved using the "1 lag restriction" technique following Roodman (2009). The excluded countries are Botswana, China, Egypt and Singapore. The outliers are singled out using OLS regressions. ***, **, * represent significance of estimates, respectively, at 1%, 5% and 10% levels. Standard errors are presented in the parentheses; the estimates in square brackets are p-values.

Table 3
Low-half and High-half Income Sample Splits
Dependent Variable: Logged per capita real (Laspeyres) GDP growth

	OLS		SUR		Fixed effects		Difference GMM		System GMM	
	a	b	a	b	a	b	a	b	a	b
	Panel A: Upper-middle and High Income Sample									
Initial GDP p.c. (log)	0.001	-0.004	-0.007**	-0.008**	-0.039***	-0.049***	-0.032	-0.064**	-0.008	-0.015*
	(0.005)	(0.006)	(0.003)	(0.004)	(0.009)	(0.009)	(0.028)	(0.023)	(0.006)	(0.008)
Military exp/GDP	**-0.001**	**0.047**	**-0.006**	**0.019**	**-0.088**	**-0.101***	**-0.161**	**-0.106****	**-0.011**	**-0.012**
	(0.046)	**(0.033)**	**(0.043)**	**(0.030)**	**(0.090)**	**(0.057)**	**(0.104)**	**(0.044)**	**(0.036)**	**(0.050)**
Pop. growth (log)	-0.009	-0.029**	-0.022**	-0.034***	0.0002	-0.023	0.035	0.008	-0.031**	-0.066**
	(0.014)	(0.011)	(0.009)	(0.008)	(0.021)	(0.018)	(0.036)	(0.038)	(0.015)	(0.025)
Life expectancy (log)	0.053***	0.088	0.116***	0.121***	0.149***	-0.052	0.067	-0.339	0.121***	0.279**
	(0.018)	(0.059)	(0.029)	(0.043)	(0.056)	(0.078)	(0.152)	(0.332)	(0.026)	(0.123)
Investment/GDP	0.107***	0.032	0.111***	0.107***	0.048	0.188***	0.028	0.195***	0.161**	0.320***
	(0.034)	(0.039)	(0.025)	(0.022)	(0.040)	(0.031)	(0.026)	(0.065)	(0.066)	(0.051)
Openness (log)	0.003	-0.002	0.003	-0.003	0.009	0.004	0.028	0.011	0.005	-0.006
	(0.002)	(0.002)	(0.002)	(0.002)	(0.007)	(0.005)	(0.026)	(0.015)	(0.007)	(0.009)
Schooling (log)	0.003	0.002	0.005	0.006	-0.011	-0.015	0.008	-0.008	0.006	0.006
	(0.008)	(0.007)	(0.007)	(0.005)	(0.014)	(0.010)	(0.039)	(0.018)	(0.009)	(0.016)
Observations	29	23	232	184	232	184	203	161	232	184
(a) Hansen's J Test							0.980	1.000	0.995	0.720
(b) Serial Corr. Test	*First-order*						0.002	0.156	0.086	0.059
	Second order						0.153	0.011	0.446	0.069
	Panel B: Lower-middle and Low Income Sample									
Initial GDP p.c. (log)	0.002	-0.001	-0.004*	-0.005**	-0.019***	-0.012**	-0.050**	-0.009	-0.007**	-0.018**
	(0.004)	(0.004)	(0.002)	(0.002)	(0.005)	(0.005)	(0.019)	(0.036)	(0.003)	(0.007)
Military exp/GDP	**-0.054**	**-0.099**	**-0.262*****	**-0.385*****	**-0.414*****	**-0.606*****	**-0.386****	**-0.698****	**-0.324**	**-0.665***
	(0.112)	**(0.104)**	**(0.056)**	**(0.074)**	**(0.074)**	**(0.104)**	**(0.180)**	**(0.300)**	**(0.209)**	**(0.341)**
									[0.126]	
Pop. growth (log)	-0.035	-0.041	0.006	0.039***	0.024**	0.059***	0.017	0.008	0.004	0.029
	(0.024)	(0.030)	(0.008)	(0.013)	(0.010)	(0.017)	(0.017)	(0.038)	(0.018)	(0.044)
Life expectancy (log)	0.065**	0.092***	0.089***	0.133***	0.034	0.065**	0.005	0.021	0.105***	0.236***
	(0.029)	(0.032)	(0.015)	(0.017)	(0.024)	(0.027)	(0.075)	(0.101)	(0.030)	(0.054)
Investment/GDP	0.069**	0.069***	0.111***	0.113***	0.169***	0.161***	0.168***	0.193***	0.142***	0.196***
	(0.030)	(0.024)	(0.015)	(0.016)	(0.024)	(0.025)	(0.047)	(0.055)	(0.035)	(0.051)
Openness (log)	-0.005	-0.005	-0.012***	-0.014***	-0.016***	-0.018***	-0.005	-0.029	-0.013**	-0.015*
	(0.004)	(0.004)	(0.003)	(0.003)	(0.005)	(0.006)	(0.014)	(0.017)	(0.005)	(0.009)
Schooling (log)	-0.011**	-0.012**	-0.007	-0.006	-0.013	-0.004	-0.029	0.009	-0.008	-0.015
	(0.005)	(0.006)	(0.004)	(0.004)	(0.012)	(0.013)	(0.024)	(0.028)	(0.007)	(0.011)
Observations	60	52	463	401	463	401	398	344	463	401
(a) Hansen's J Test							0.995	0.270	0.994	0.996
(b) Serial Corr. Test	*First-order*						0.001	0.005	0.001	0.003
	Second order						0.740	0.419	0.520	0.669

Note: Columns "a" and "b" estimate military expenditure and economic growth relationship, respectively, with and without outliers. The estimated results for GMM estimators are achieved using the "1 lag restriction" technique following Roodman (2009). Eliminated countries from high-half income group are Argentina, Cyprus, Ireland, Iran, Mexico and Singapore, while for low-half income subsample are Botswana, Egypt, Guyana, Jordan, Mozambique, Rwanda, Sierra Leone and Zambia. The outliers are singled out using OLS regressions. ***, **, * represent significance of estimates, respectively, at 1%, 5% and 10% levels. Standard errors are presented in the parentheses; the estimates in square brackets are p-values.

Table 4
Sample Splits for Income Rankings
Dependent Variable: Logged per capita real (Laspeyres) GDP growth

Panel A: Measures of Quantitative Significance

Income group	OLS	SUR	Fixed effects	Difference GMM		System GMM	
				a	b	a	b
Rank 1	-0.013	-0.249***	-0.484***	-0.426*	-0.326**	-0.237	-0.187
	(0.116)	(0.069)	(0.088)	(0.236)	(0.152)	(0.242)	(0.332)
Rank 2	-0.069	-0.186**	0.026	0.024	-0.194	-0.169	-0.157
	(0.061)	(0.092)	(0.136)	(0.177)	(0.164)	(0.100)	(0.096)
Rank 3	0.065	-0.181	-0.266	-0.209	0.337	-0.181	-0.181
	(0.424)	(0.215)	(0.349)	(0.282)	(0.416)	(0.234)	(0.234)
Rank 4	0.006	-0.035	-0.073	-0.084*	-0.038	-0.033	-0.027
	(0.037)	(0.028)	(0.046)	(0.044)	(0.081)	(0.032)	(0.032)

Panel B: Measures of Quantitative Significance, Outliers Removed

Income group	OLS	SUR	Fixed effects	Difference GMM		System GMM	
				a	b	a	b
Rank 1	-0.117	-0.448***	-0.697***	-0.670	-0.799*	-0.473*	-0.651*
	(0.131)	(0.082)	(0.123)	(0.410)	(0.428)	(0.277)	(0.323)
				[0.111]			
Rank 2	0.185	-0.171	-0.048	-0.048	-0.117	-0.171	-0.171
	(0.196)	(0.168)	(0.214)	(0.247)	(0.481)	(0.119)	(0.118)
Rank 3	0.569	0.017	-0.071	-0.071	0.208	0.017	0.017
	(0.231)	(0.218)	(0.354)	(0.178)	(0.249)	(0.232)	(0.232)
Rank 4	0.117	0.046	-0.399**	-0.356*	-0.194	0.052	0.065
	(0.083)	(0.074)	(0.170)	(0.181)	(0.239)	(0.102)	(0.104)

Note: Columns “a” under the GMM specifications estimate military expenditure and economic growth relationship using all possible lags, while the results in columns “b” are achieved using the “1 lag restriction” technique following Roodman (2009). All specifications employ log of initial income, growth rate of population, log of life expectancy, investment ratio, log of openness and schooling, and time fixed effects as an additional control set. The excluded countries from income rank 1 sample are Egypt, Guyana, Mozambique, Rwanda, Sierra Leone and Zambia; from income rank 2 are Brazil, Jordan, Korea Rep, Nicaragua and Panama; from income rank 3 are Cyprus, Iran and Mexico; from income rank 4 are Israel and Norway. The outliers are singled out using OLS regressions. The number of observations in Panel A are 44 for OLS, 335 for SUR, FE and GMM System and 286 for GMM Difference in income rank 1 sample; 16, 128 and 112 in income rank 2 sample; 11, 88 and 77 in income rank 3 sample; 18, 144 and 126 in income rank4 sample. The respective figures for Panel B are 38, 288 and 245 in income rank 1; 11, 88 and 77 in income rank 2; 8, 64 and 56 in income rank 3; 16, 128 and 112 in income rank 4. ***, **, * represent significance of estimates, respectively, at 1%, 5% and 10% levels. Standard errors are presented in the parentheses; the estimates in square brackets are p-values.

Table 5
Sample Splits for Different Types of Economies
Dependent Variable: Logged per capita real (Laspeyres) GDP growth

Panel A

Estimates of Military expenditure for different type of Economies

Type of Economy	OLS	SUR	Fixed effects	Difference GMM		System GMM	
				a	b	a	b
Advanced	0.122	0.076	-0.155	-0.145	-0.206	0.088	0.099
Economies	(0.106)	(0.080)	(0.172)	(0.161)	(0.239)	(0.097)	(0.119)
Latin America	0.009	-0.312**	-0.265	-0.226	-0.337	-0.287	-0.474*
and Caribbean	(0.250)	(0.154)	(0.214)	(0.453)	(0.443)	(0.202)	(0.227)
Sub-Saharan	0.108	-0.712***	-1.059***	-1.083**	-0.854*	-0.728	-0.959**
Africa	(0.263)	(0.131)	(0.151)	(0.379)	(0.458)	(0.427)	(0.458)
						[0.101]	
East Asia and the	-1.181	0.501***	0.447	0.447	0.208	0.501**	0.501**
Pacific	(1.795)	(0.192)	(0.294)	(0.283)	(0.294)	(0.200)	(0.200)
Middle East &	0.168**	-0.078	-0.171	-0.171	-0.149	-0.078	-0.078
North Africa	(0.003)	(0.076)	(0.123)	(0.124)	(0.133)	(0.056)	(0.056)

Panel B

Estimates of Military expenditure for different type of Economies, Outliers Removed

Type of Economy	OLS	SUR	Fixed effects	Difference GMM		System GMM	
				a	b	a	b
Advanced	0.132	0.081	-0.394**	-0.371**	-0.627*	0.089	0.097
Economies	(0.094)	(0.076)	(0.172)	(0.139)	(0.305)	(0.114)	(0.129)
Latin America	0.053	-0.147	-0.256	-0.253	-0.116	-0.148	-0.148
and Caribbean	(0.268)	(0.129)	(0.187)	(0.171)	(0.372)	(0.153)	(0.154)
Sub-Saharan	-0.069	-1.193***	-1.420***	-1.538***	-1.768***	-1.202***	-1.331***
Africa	(0.395)	(0.158)	(0.177)	(0.188)	(0.230)	(0.277)	(0.228)
East Asia and the	1.881	0.279	0.249	0.249	0.249	0.279	0.279
Pacific	(0.375)	(0.179)	(0.346)	(0.352)	(0.352)	(0.235)	(0.235)
Middle East &	0.063	-0.218**	-0.213*	-0.213***	-0.213***	-0.218***	-0.218***
North Africa	(0.146)	(0.090)	(0.107)	(0.047)	(0.047)	(0.053)	(0.053)

Note: Columns "a" under the GMM specifications estimate military expenditure and economic growth relationship using all possible lags, while the results in columns "b" are achieved using the "1 lag restriction" technique following Roodman (2009). All specifications employ log of initial income, growth rate of population, log of life expectancy, investment ratio, log of openness and schooling, and time fixed effects as an additional control set. The excluded countries from Advanced Economies sample are Spain, Ireland and Portugal; from Latin America and the Caribbean sample - Brazil, Guyana, Nicaragua, Panama and Paraguay; from Sub-Saharan Africa sample - Botswana, Mozambique, Mauritania, Rwanda, Sierra Leone and Zambia; from East Asia and the Pacific sample - China, Indonesia, Korea Rep and Papua New Guinea; from Middle East and North Africa sample - Iran, Israel and Jordan. The outliers are singled out using OLS regressions. The number of observations in Panel A are 20 for OLS, 160 for SUR, FE and GMM System and 140 for GMM Difference in Advanced Economies sample; 19, 151 and 131 in Latin America and Caribbean sample; 26, 195 and 165 in Sub-Saharan Africa sample; 9, 69 and 60 in East Asia and the Pacific sample; 9, 69 and 63 in Middle East and North Africa sample. The respective figures for Panel B are 17, 136 and 119 in Advanced Economies sample; 14, 111 and 96 in Latin America and Caribbean sample; 20, 149 and 125 in Sub-Saharan Africa sample; 8, 40 and 35 in East Asia and the Pacific sample; 7, 48 and 42 in Middle East and North Africa sample. ***, **, * represent significance of estimates, respectively, at 1%, 5% and 10% levels. Standard errors are presented in the parentheses; the estimates in square brackets are p-values.

Table 6
Upward Movers and Asian Tigers
Dependent Variable: Logged per capita real (Laspeyres) GDP growth
Estimation: System GMM estimation with Windmeijer (2005) Small Sample Robust Correction

Country	Income rank, 1970	Income rank, 2005	Average Mil. exp. share	Average Growth Rate	Coeff.	S. E.	p value
			Remove Outliers				
Botswana	1	3	3.32	5.75		**Mil.exp/GDP**	
China	1	2	1.73	6.90	-3.021	1.444	0.039
Egypt	1	2	8.66	3.03		**Mil*GDP**	
Singapore	3	4	4.61	5.27	0.322	0.157	0.044
			Remove Escapees from Low Income Group				
Fiji	1	2	1.25	1.99			
Guyana	1	2	2.76	2.54			
Honduras	1	2	1.50	1.04			
Indonesia	1	2	2.34	4.19			
Malaysia	1	3	3.73	4.01		**Mil.exp/GDP**	
Mauritius	1	3	0.28	2.87	-3.101	1.457	0.037
Morocco	1	2	4.10	2.38		**Mil*GDP**	
Paraguay	1	2	1.35	1.44	0.331	0.157	0.039
Sri Lanka	1	2	2.52	3.70			
Syria	1	2	9.05	1.48			
Thailand	1	3	2.88	4.46			
Tunisia	1	2	2.10	2.60			
			Remove Escapees from Low and Lower-Middle Income Group				
Algeria	2	3	2.57	1.28			
Brazil	2	3	1.52	2.29			
Chile	2	3	4.16	2.29			
Colombia	2	3	2.31	2.39			
Ecuador	2	3	2.19	1.77			
El Salvador	2	3	1.79	0.99			
Guatemala	2	3	1.13	1.51		**Mil.exp/GDP**	
Korea Rep.	2	4	3.85	5.47	-2.708	1.524	0.080
Malaysia	1	3	3.73	4.01		**Mil*GDP**	
Mauritius	1	3	0.28	2.87	0.287	0.164	0.085
Panama	2	3	0.93	3.47			
Peru	2	3	3.05	1.28			
South Africa	2	3	2.63	1.38			
Thailand	1	3	2.88	4.46			
Turkey	2	3	4.01	2.51			
Uruguay	2	3	2.11	2.20			
			Remove Asian Tigers				
Indonesia	1	2	2.34	4.19		**Mil.exp/GDP**	
Korea Rep.	2	4	3.85	5.47	-2.955	1.544	0.059
Malaysia	1	3	3.73	4.01		**Mil*GDP**	
Thailand	1	3	2.88	4.46	0.318	0.169	0.063

Note: The estimation results are achieved using the “1 lag restriction” technique following Roodman (2009). All specifications employ log of initial income, growth rate of population, log of life expectancy, investment ratio, log of openness and schooling, and time fixed effects as an additional control set.

Table 7
Exclusion of Countries with High Military Expenditure Shares
Dependent Variable: Logged per capita real (Laspeyres) GDP growth
Estimation: System GMM estimation with Windmeijer (2005) Small Sample Robust Correction

Country	Income rank, 1970	Income rank, 2005	Average Mil. exp. share	Average Growth Rate	Coeff.	S. E.	p value
Remove Outliers							
Botswana	1	3	3.32	5.75		**Mil.exp/GDP**	
China	1	2	1.73	6.90	-3.021	1.444	0.039
Egypt	1	2	8.66	3.03		**Mil*GDP**	
Singapore	3	4	4.61	5.27	0.321	0.157	0.044
Remove High Military Exp. Share, Low Income Countries							
						Mil.exp/GDP	
Egypt	1	2	8.66	3.03	-3.027	1.523	0.050
						Mil*GDP	
Syria	1	2	9.05	1.48	0.321	0.164	0.053
Remove High Military Exp. Share, High Income Countries							
						Mil.exp/GDP	
Israel	4	4	14.96	2.42	-3.476	1.984	0.083
						Mil*GDP	
United States	4	4	5.37	1.68	0.401	0.241	0.100
Remove Both Subsets							
Egypt	1	2	8.66	3.03		**Mil.exp/GDP**	
Syria	1	2	9.05	1.48	-3.369	1.871	0.075
Israel	4	4	14.96	2.42		**Mil*GDP**	
United States	4	4	5.37	1.68	0.375	0.225	0.099

Note: The estimation results are achieved using the "1 lag restriction" technique following Roodman (2009). All specifications employ log of initial income, growth rate of population, log of life expectancy, investment ratio, log of openness and schooling, and time fixed effects as an additional control set.

Table 8
Different Time Windows
Dependent Variable: Logged per capita real (Laspeyres) GDP growth
Estimation: System GMM estimation with Windmeijer (2005) Small Sample Robust Correction

	1970-1995 (1)	1980-2010 (2)	1990-2010 (3)
Initial GDP p.c. (log)	-0.028***	-0.018***	-0.019**
	(0.009)	(0.006)	(0.007)
Mil. exp/GDP	-4.381***	-2.217	-3.216**
	(1.637)	(1.564)	(1.439)
		[0.160]	
Mil*GDP	0.486**	0.241	0.338**
	(0.189)	(0.176)	(0.156)
		[0.174]	
Control Set	Yes	Yes	Yes
Observations	431	614	439
SPECIFICATION TESTS (*p* -values)			
(a) Hansen Test:	0.352	0.926	0.230
(b) Serial Corr. Test:			
First-order	0.031	0.000	0.001
Second-order	0.767	0.554	0.874

Note: The estimation results are achieved using the "1 lag restriction" technique following Roodman (2009). Additional control set includes growth rate of population, log of life expectancy, investment ratio, log of openness and schooling, and time fixed effects. ***, **, * represent significance of estimates, respectively, at 1%, 5% and 10% levels. Standard errors are presented in the parentheses; the estimates in square brackets are p-values.

Table 9
Alternative Data Sources and Measurements
Dependent Variable: Logged per capita real (Laspeyres) GDP growth
Estimation: GMM estimation with Windmeijer (2005) Small Sample Robust Correction

	(1)	(2)	(3)
Initial GDP p.c. (log)	-0.010**	-0.043**	-0.014*
	(0.004)	(0.018)	(0.008)
Mil. exp/GDP	-2.725**	-0.470**	-5.666***
	(1.136)	(0.183)	(1.409)
Mil*GDP	0.386**		0.624***
	(0.168)		(0.182)
Mil*Rank		0.117**	
		(0.052)	
Control Set	Yes	Yes	Yes
Observations	688	601	342
SPECIFICATION TESTS (*p* -values)			
(a) Hansen Test:	0.971	0.796	0.142
(b) Serial Corr. Test:			
First-order	0.000	0.015	0.000
Second-order	0.695	0.260	0.536

Note: The estimation results under the columns 1 and 3 are achieved using System GMM; while under the column 2 Difference GMM is used. In addition, column 1 and 3 also employs the "1 lag restriction" technique following Roodman (2009). Additional control set includes growth rate of population, log of life expectancy, investment ratio, log of openness and schooling, and time fixed effects. ***, **, * represent significance of estimates, respectively, at 1%, 5% and 10% levels. Standard errors are presented in the parentheses.

Appendix A: List of Countries

Country	Income Rank, 1970	Income Rank, 2005	Country	Income Rank, 1970	Income Rank, 2005	Country	Income Rank, 1970	Income Rank, 2005
Algeria	2	3	Greece	4	4	Pakistan	1	1
Argentina	3	3	Guatemala	2	3	Panama	2	3
Australia	4	4	Guyana	1	2	Papua New Guinea	1	1
Austria	4	4	Honduras	1	2	Paraguay	1	2
Bangladesh	1	1	Hungary	3	4	Peru	2	3
Belgium	4	4	India	1	1	Philippines	1	1
Bolivia	2	2	Indonesia	1	2	Portugal	3	4
Botswana	1	3	Iran	3	3	Rwanda	1	1
Brazil	2	3	Ireland	3	4	Senegal	1	1
Burundi	1	1	Israel	4	4	Sierra Leone	1	1
Cameroon	1	1	Italy	4	4	Singapore	3	4
Canada	4	4	Jamaica	3	3	South Africa	2	3
Central African Rep.	1	1	Jordan	2	2	Spain	4	4
Chile	2	3	Kenya	1	1	Sri Lanka	1	2
China	1	2	Korea, Rep. of	2	4	Sudan	1	1
Colombia	2	3	Liberia	1	1	Sweden	4	4
Congo, Dem. Rep.	1	1	Malawi	1	1	Switzerland	4	4
Congo, Rep. of	1	1	Malaysia	1	3	Syria	1	2
Costa Rica	3	3	Mali	1	1	Thailand	1	3
Cote d'Ivoire	1	1	Mauritania	1	1	Togo	1	1
Cyprus	3	4	Mauritius	1	3	Tunisia	1	2
Ecuador	2	3	Mexico	3	4	Turkey	2	3
Egypt	1	2	Morocco	1	2	Uganda	1	1
El Salvador	2	3	Mozambique	1	1	United Kingdom	4	4
Fiji	1	2	Nepal	1	1	United States	4	4
Finland	4	4	Netherlands	4	4	Uruguay	2	3
France	4	4	New Zealand	4	4	Venezuela	3	3
Gambia	1	1	Nicaragua	2	1	Zambia	1	1
Germany	4	4	Niger	1	1	Zimbabwe	1	1
Ghana	1	1	Norway	4	4			

Appendix B: Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
GDP p.c. (log)	801	8.32	1.33	4.77	10.82
GDP per capita growth rate	796	0.02	0.03	-0.36	0.19
Military Expenditure over GDP	778	0.028	0.028	0	0.29
Population Growth rate	801	0.07	0.01	0.01	0.14
Real Investment ratio	801	0.23	0.09	0.04	0.72
Life Expectancy (log)	801	4.13	0.19	3.16	4.40
Schooling (log)	801	1.61	0.67	-1.24	2.57
Openness (log)	801	3.99	0.62	2.21	6.06

Note: All descriptive statistics are based on panel country averages for the period of 1970-2010 and 89 countries sample.